Rising Above the Challenge: Management of Aniseikonia using Empirically Designed Scleral Lenses for a Tilted Corneal Graft

Alia Cappellani, OD, FAAO[1], Latricia Pack, OD, FAAO[2]

Northeastern State University Oklahoma College of Optometry

Cornea and Contact Lens Resident[1], Professor[2]

Background

Penetrating keratoplasty (PK) remains an effective surgical procedure for a variety of corneal disorders; however, postoperative ocular shape abnormalities can complicate both visual function and rehabilitation methods. While scleral contact lenses offer a corrective option for refractive issues such as anisometropia, irregular astigmatism and subsequent aniseikonia that cannot be fully addressed through spectacle prescription, variable corneal contour pose obstacles to proper lens positioning.[1,2] Fortunately, with the advent of technology to reliably quantify the corneoscleral profile, highly customized scleral lens designs can closely match unique ocular shapes maximizing fitting success and patient satisfaction.[3]

The following case report highlights the use of empirically designed scleral lenses to manage symptoms of aniseikonia after unilateral PK for a patient with a tilted corneal graft.

Case Description

Demographics	Entrance Testing	Anterior Segment
• 56-year-old Caucasian male • Referred from the VA for symptoms of aniseikonia • OHx: PKP OD 2' corneal trauma • H/o corneal GP wear OU	• Spectacle Rx BCVA OD: +1.50-4.25x105 20/40 OS: +5.50-3.00x150 20/30	• Clear, centered graft with **proud prolate contour marked superior protrusion OD** • Unremarkable OS • Endothelial cell count: 1473 OD / 2580 OS

The patient was initially fit with a diagnostic scleral lens OD and a corneal gas permeable (GP) lens OS. After two attempts to adjust the fit, the right lens yielded touch over the superior graft-host junction with excessive inferior clearance. Given the complexity of the fit and limitation of diagnostic scleral lenses, a more customized design was required. Additionally, the patient opted for a scleral lens for the left eye after experiencing the difference in lens awareness between scleral and corneal GP lenses.

Case Details

OD

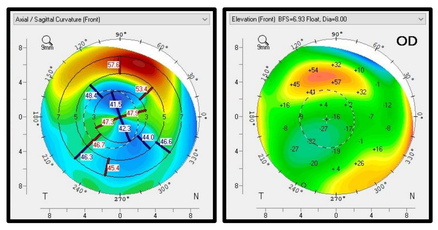

Figure 1: Axial curvature and elevation map of the right eye showing a post-PK steep superior cornea with a rapid change to flat curvature and prominent elevation at the graft-host junction.

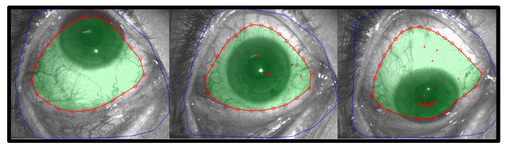

Figure 2: Image set from the **sMap3D (Visionary Optics)** corneoscleral topographer outlining 1 million data points to create highly detailed, 360-degree maps of the right cornea and sclera.

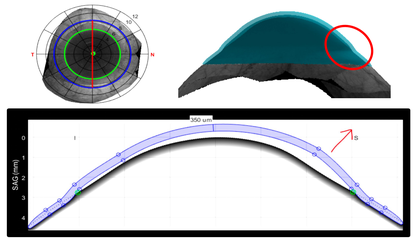

Figure 3: The red line on the polar graph (top left) define the 270- to 90-degree meridian shown in the sagittal height image derived from the sMap3D data (bottom) demonstrating the highly irregular cornea for which a customized lens was required. A 16.5mm freeform **Latitude** scleral lens (shown in purple) was designed to fit over the challenging corneal profile, particularly at the area of transition between the host bed and donor tissue. The top right image shows the lens superimposed on the eye.

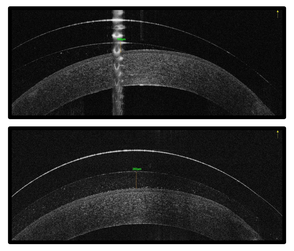

Figure 4: Ocular coherence tomography (OCT) showing superior lens touch with a conventional scleral lens (top) verses the freeform **Latitude** lens design (bottom) contouring the exact ocular shape, resulting in a more uniform vault over the entire cornea with 282um of central clearance after 4hr of wear.

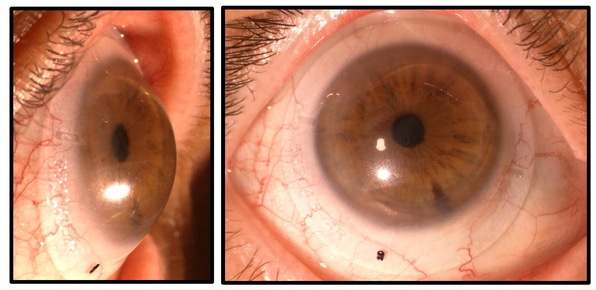

Figure 5: The **Latitude** scleral lens (7.42mm/-2.00DS/16.5mm/4918um sag) allowed for a well centered, multi-zoned aligned fit over the entire cornea, full limbal clearance and excellent edge alignment 360°. The lens was comfortable and final BCVA OD was **20/20**$^{-3}$.

OS

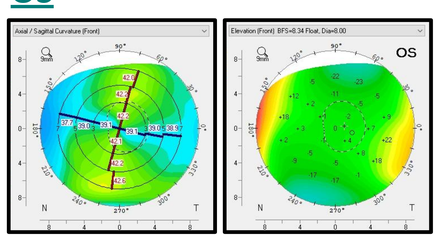

Figure 6: Axial curvature and elevation map of the left eye showing regular WTR corneal astigmatism.

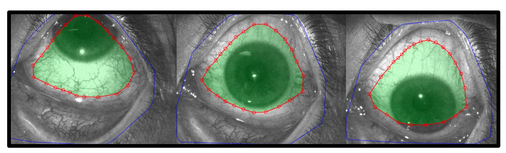

Figure 7: Image set from the **sMap3D** corneoscleral topographer outlining 1 million data points to create highly detailed, 360-degree maps of the left cornea and sclera.

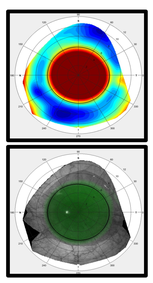

Figure 8: sMap3D data showing WTR scleral toricity (top) for which a toric haptics are required for a stable fit shown with the simulated fluorescence pattern (bottom)

Predicted	Parameters	Final
4001 µm	**Sagittal Height**	4374 µm
8.49	**BCR** (mm)	9.00
16.0	**Diameter** (mm)	16.5
+4.00 DS	**Power**	+6.75 DS
150µm @66°	**TPC**	300µm @66°
8.27/2.10	**PC/WC 1** (mm)	7.89/2.35
9.50/0.75	**PC/WC 2** (mm)	9.50/0.75
13.50/0.50	**PC/WC 3** (mm)	13.5/0.75
14.5/0.40	**PC/WC 4** (mm)	14.5/0.40

Table 1: Predicted 1st lens from based on sMap3D data compared to the final **Europa** lens parameters.

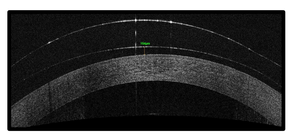

Figure 9: OCT showing vault over entire cornea, 154um centrally, after 4hrs of wear.

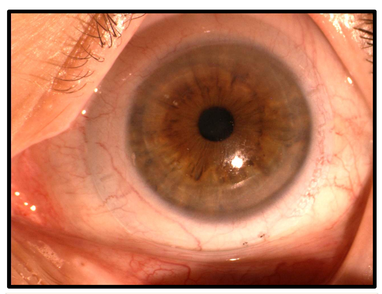

Figure 10: The **Europa** scleral lens allowed for a well centered lens with full central/limbal clearance and excellent edge alignment 360°. The lens was comfortable and final BCVA OS was **20/25**$^{-1}$.

Conclusion

This case demonstrates the ability of data-driven customized scleral lens design to remediate challenges encountered with alternative lens designs ultimately providing the patient with good vision, comfort and overall satisfaction. Recent advances in corneoscleral profilometry technology widens the breadth of strategies used to successfully and efficiently cater to unique ocular shapes while limiting adverse events. Modern diagnostic instrumentation in conjunction with innovative design software offer more options to further enhance the ability to deliver the best care to our patients.

References

1. Barnett, M. et al (2016). Use of Scleral Lenses and Miniscleral Lenses After Penetrating Keratoplasty. *Eye & Contact Lens: Science & Clinical Practice, 42* (3), 185-189.

2. Penbe, A. , Kanar, H. & Simsek, S. (2021). Efficiency and Safety of Scleral Lenses in Rehabilitation of Refractive Errors and High Order Aberrations After Penetrating Keratoplasty. *Eye & Contact Lens: Science & Clinical Practice, 47* (5), 301-307.

3. Barnett, M., et al. (2021). BCLA CLEAR-Scleral lenses. *Contact Lens and Anterior Eye*, *44*(2), 270-288.

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